

assess the degree of intra and intermolecular cross-linking in the collagen of healing wounds. In experimental animals scar tissue was examined at intervals. The collagen was extracted in the form of "polymeric" collagen. Amino-acid analysis gave an estimate of its purity and presence of substances other than collagen. The extent of intramolecular cross-linking was assessed in human scar tissue removed after death from people who had suffered from rheumatoid arthritis. This tissue was treated with cysteamine or pepsin or cold sodium hydroxide. Subsequent extraction with water at 60° or 100° C dissolved some of the collagen to give gelatine solutions. The amount gelatinized gave an estimate of intramolecular cross-linking, for each of the three reagents has specificity for bonds believed to be present in such collagen cross-links. Pepsin was the most effective of the three reagents, resulting in considerably more than 90 per cent gelatinization. The extent of gelatinization after the pretreatments varied little with the age of the scar, although four week old tissue was possibly somewhat more resistant than one week old tissue.

MEMORY

Psychology versus Physiology

THE mechanisms of memory will not be elucidated entirely by physiologists, and when they have explained all they can about this phenomenon, there will still be something for the psychologists to work on. This was the message of the Stevenson lecture given at Bedford College, London, on November 5 by Dr D. E. Broadbent, director of the MRC Applied Psychology Unit.

Citing some quite simple psychological experiments, he argued that memory is less simple than suggested by physiological theories that suppose a temporary first stage and a later more permanent stage. Dr Broadbent called this explanation of short and long term memory the "wet concrete theory". It implies that memory is at first pliable and vulnerable to interference—the stage at which a telephone number is quickly forgotten—and later sets permanently into a memory that will last a long time.

This theory involves a change from temporary to permanent memory that might be explained, for example, by the transfer of information from RNA to protein. Psychological experiments, however, indicate that short and long term memory differ in the organization of the information. Evidence comes from variations in the efficiency with which subjects recall similar sounds as opposed to words with similar meanings—acoustic versus semantic similarity. If a subject hears a list of sounds which are all quite similar such as C, P, B, T, he is less likely to recall them correctly than he would a list in which each item sounded different, and this effect is more marked in the short term than the long term. When he has to learn words with a similar meaning he has more difficulty remembering them correctly in the long term than he would words with quite different meanings. In the short term, however, the difficulty of remembering words with similar meanings is much less marked. This is the situation in which the student of Russian finds himself if he learns the Russian for "serene" and "tranquil" at the same time. Immediately after

learning them the words are clearly distinguishable, but later it is much more difficult to remember which word means serene and which tranquil.

These contrasting patterns of errors, with different types of information forgotten more easily in long and short term memory, suggest that it is not a simple matter of making a temporary memory permanent, as the physiologists suggest. Rather, the organization of the information seems to be different in the two cases. Indeed, Dr Broadbent feels that the division between short and long term memory which the wet concrete brigade are studying is not the same as that which the psychologists have found, for different time scales seem to be involved. Experiments in which lists of words are recalled suggest that short term memory lasts less than a minute, which is faster than physiological techniques have revealed.

Dr Broadbent concluded that the psychologists have revealed mechanisms of memory which do not yet have any suggested physiological explanation. This, he said, can help to clarify the proper relation between physiology and psychology. To begin with, it is necessary to know what behaviour is, before it can be explained—the psychologists are at this stage with memory. But in any case, he said, there are some problems in behaviour which are topics for study in their own right, about which physiology has nothing to say. Some kinds of memory could fit into this category. To use a computing analogy, they may be a matter of programming rather than electronics.

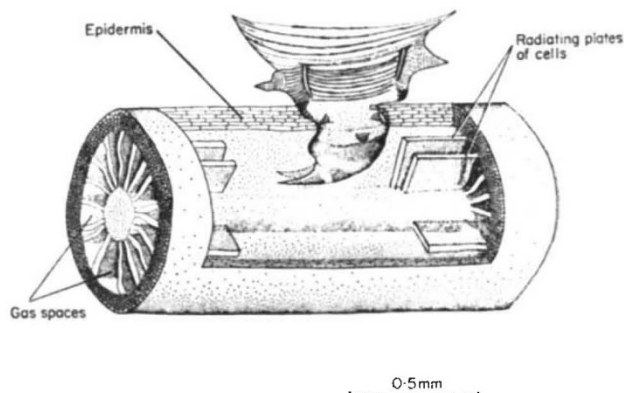
ENTOMOLOGY

Plants supply Oxygen

from our Botany Correspondent

SEVERAL underwater insects obtain some of their oxygen from the gas spaces inside aquatic plants by piercing the epidermis with special pointed spiracles. Recent work has shown that they cannot all do so in open water; the larvae and pupae of *Notiphila riparia*, a sandfly, and *Erioptera squalida*, a crane fly or daddy-long-legs, need the support of the mud in which they are embedded at the bottom of the water. D. F. Houlihan now thinks that the shortage of oxygen in the mud is such that the insects rely entirely on the plants for their supply of the gas (*J. Zool.*, **159**: 249; 1969).

Both species of insects, which spend their adulthood in the air, lay eggs on leaves or other objects on the



The base of the puparium *N. riparia* in a root of *Typha*, with some of the epidermis and radiating plates of cells removed.